

Towards a circular economy for plastics: Can solvent pretreatment enhance closed loop recycling?

Sibel Ugduler ^a, Kevin Van Geem ^b, Steven De Meester ^a

^aDepartment of Green Chemistry and Technology
Ghent University - Campus Kortrijk
Graaf Karel de Goedelaan 5, 8500 Kortrijk

^bDepartment of Materials, Textiles and Chemical Engineering
Ghent University-Laboratory for Chemical Technology (LCT)
Technologiepark 914, 9052 Ghent, Belgium

Plastics are indispensable in today's modern life due to their great functionality and low production costs. Whereas the production processes of plastics are very mature, the current recycling market is still in its infancy, often limited to open loop recycling towards bulk applications. Because of their negative impact on the environment, plastic also gained a negative perception, despite the service they provide during their lifetime. Therefore, there is a growing demand for sustainable technologies towards closed loop plastic waste recycling. One of the issues that impedes high end recycling, e.g. towards food applications is the presence of additives, that are incorporated into plastics to improve their functionality during lifetime, but that are not suited in their 'second life', or even toxic when used in food contact. Whereas current recycling companies merely perform physical separations, a chemical pretreatment of plastic waste, for example with solvents, might become in a true circular economy.

This presentation focuses on the potential of solvent based additive extraction methods to extract various additives from different types of plastic waste. For this purpose, first a review is given on the range of chemical properties abundant in the plastic. Second, theoretical considerations are made relying on diffusion and solubility theories; for example by using Hansen solubility parameters in order to assess the suitability of selected solvents beforehand for the extraction of different type of additives. Third, experiences from literature and industry are reviewed, amongst others related to conventional and pressure assisted solid-liquid extraction methods and dissolution-precipitation techniques. Finally, reflections from industrial experiences are included and suggestions towards further developments are postulated.

It is, amongst others, concluded that the use of theoretical approaches to (qualitatively) predict solvent performance towards closed loop recycling of plastics would strongly accelerate the research effort and costs for optimization in the extraction of various components from different type of plastics. The extrapolation of such considerations towards industrial applications would also result in more efficient and profitable plastic recycling processes.